

Bird diversity of Panboola: a review of 20 years of survey data



A report prepared for Pambula Wetlands and Heritage Project Inc.

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Definitions & Acronyms used within this report

BC Act	NSW Biodiversity Conservation Act 2016
Bonn	The Convention on the Conservation of Migratory Bird Species
CAMBA	China-Australia Migratory Bird Agreement
EEC	Endangered Ecological Community
EPBC Act	<i>Commonwealth Environment Protection and Biodiversity Conservation Act 1995</i>
FB	Freshwater Billabong
FF	Floodplain Forest
FSCB	Far South Coast Birdwatchers
JAMBA	Japan-Australia Migratory Bird Agreement
LGA	Local Government Area
LLS	Local Land Services
OEH	NSW Office of Environment & Heritage
Panboola	Panboola Wetlands
PWHP	Pambula Wetlands and Heritage Project Inc
RFS	Riparian and Floodplain Shrubland
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
SEPP	State Environmental Planning Policy
SM	Saltmarsh
WBS	Waterbird Sanctuary

Table of Contents

1	INTRODUCTION	1
1.1	STUDY AIMS	2
2	METHODOLOGY	4
2.1	BIRD SURVEYS.....	4
2.2	STUDY AREA	5
2.2.1	Floodplain Forest.....	5
2.2.2	Freshwater Billabong	6
2.2.3	Saltmarsh	7
2.2.4	Riparian and Floodplain Shrubland.....	8
2.3	ANALYSIS OF DATA	9
2.4	LIMITATIONS.....	9
3	RESULTS	10
3.1	OVERALL SPECIES DIVERSITY	10
3.2	SEASONALITY OF SPECIES PRESENCE	10
3.3	HABITAT OCCUPANCY.....	15
3.4	THREATENED AND MIGRATORY SPECIES	20
3.5	SEASONAL SPECIES DIVERSITY BY YEAR.....	21
3.6	OPPORTUNISTIC DATA.....	22
4	DISCUSSION	24
4.1	OVERALL SPECIES DIVERSITY	24
4.2	SEASONALITY OF SPECIES PRESENCE	24
4.3	HABITAT OCCUPANCY.....	24
4.4	THREATENED AND MIGRATORY SPECIES	25
4.5	SEASONAL SPECIES DIVERSITY BY YEAR.....	25
4.6	OPPORTUNISTIC DATA.....	25
5	CONCLUSION.....	26
6	REFERENCES	27
7	APPENDICES	I
	APPENDIX 1 – QUALIFICATIONS AND EXPERIENCE OF PERSONNEL	II

Figures, Maps & Tables

Figure 1: Number of species detected each year at Panboola.	10
Figure 2: Number of species detected each season in each year at Panboola.....	22
Map 1: The location and extent of Panboola (image courtesy of Google Earth).	1
Map 2: Location of bird survey transects at Panboola.....	4
Table 1: Number of species present during each season at Panboola.	10
Table 2: Number of bird surveys that each bird species was detected during each season (maximum number of surveys is autumn = 19, winter = 19, spring = 20, summer = 19; total 77 surveys).	11
Table 3: Number of bird species recorded within each habitat type over the 20-year survey period	15
Table 4: Number of surveys that each species was detected within each habitat type. ...	15
Table 5: Threatened and Migratory species recorded at Panboola and their legal status (BC Act= NSW Biodiversity Conservation Act 2016, EPBC Act= Commonwealth Environment Protection and Biodiversity Conservation Act 1999, V = vulnerable, E = endangered, CE = critically endangered, LM= Listed Marine, B= Bonn, C=CAMBA, J=JAMBA, R=ROCKAMBA.	20
Table 6: Bird species recorded outside of formal bird surveys (ie, opportunistic records).	22

1 INTRODUCTION

Panboola, located adjacent to Pambula on the far south coast, New South Wales, is a 82hectare long-term rehabilitation project. Panboola is located on the original site of the township of Pambula. However, regular flooding saw the township moved to the current site (George and Raymond, 2006).

The town of Pambula is to the north of the site, open pasture borders Panboola to the east. Pambula River and open pasture adjoin the site to the west and Ben Boyd National Park, Pambula River and SEPP 14 wetlands adjoin the southern boundaries (**Map 1**).



Map 1:The location and extent of Panboola (image courtesy of Google Earth).

There is a compelling need to protect wetlands as they are in decline worldwide. Wetlands are extremely important ecosystems that perform important functions (Finlayson and Rea, 1999). Restoring and protecting wetlands has many benefits, including habitat for threatened species, flood mitigation, water quality improvement, aesthetics and nutrient cycling (Mitsch and Gosselink, 2000). Rehabilitation efforts began on the site in 1997 at the Pambula Racecourse which was, like the original township, abandoned due to frequent flooding. Pambula Landcare conducted a wetland management program at the Pambula racecourse (29 hectares) funded by Department of Land and Water Conservation. Panboola's benefactor Alexandra Seddon, purchased a six hectare portion to the north of the site, also in 1997. In 2001, a voluntary conservation agreement was placed over two hectares of this land that is now known as the Waterbird Sanctuary. In the same year, 42 hectares of adjoining river flats were purchased by

Alexandra. In 2002, the racecourse was re-gazetted as Pambula Wetlands Heritage Reserve which is co-managed by the Pambula Wetlands and Heritage Reserve Trust in conjunction with Pambula Wetlands and Heritage Project Inc. that has responsibility for the remaining Panboola land. A voluntary conservation agreement was placed over the remaining four hectares of the Waterbird Sanctuary in 2003 (IronoutVCAConsultants, 2006). In 2011, a further five hectares was donated bringing Panboola's extent to a total of 82 hectares.

A diverse range of ecosystems are found within Panboola including fresh water billabongs leading to saline areas, saltmarsh and mangroves (PWHP, 2014, IronoutVCAConsultants, 2006). An area of farmland is managed in an environmentally sensitive way to provide for costs such as insurances and maintenance (PWHP, 2014). Panboola has within its borders endangered ecological communities (EEC), threatened species and areas of cultural and heritage significance which are in need of protection (IronoutVCAConsultants, 2006). Panboola is delineated by different management units for ease of management. These being, Tips Billabong, Waterbird Sanctuary, Marsh Paddock, Eastern Section of Marsh Paddock, Pambula Wetlands and Heritage Reserve, The Bubble, Watsons, Farmland and Pambula River Bank and Riparian Vegetation (IronoutVCAConsultants, 2006). There are also several European Heritage buildings on the site (IronoutVCAConsultants, 2006).

Historically this land was used for agricultural practices (IronoutVCAConsultants, 2006) which posed a threat to the wetland system and the adjoining SEPP 14 – Coastal Wetlands and nearby Pambula Lake (Growers, 2011). Threats to wetland ecosystems include weed invasion, grazing and watering of stock, erosion (Finlayson and Rea, 1999) and more importantly lack of recognition of wetlands as linked systems (Finlayson and Rea, 1999). Rehabilitation of Panboola's ecosystems will remediate the threats that were at play.

Work has been occurring on the site since 1997. While much of the rehabilitation work at Panboola is ongoing there are many projects which have been completed. These include the 'Saltmarsh Rehabilitation Project', involving the creation of a 20-metre wide wildlife corridor which runs across the floodplain, linking the Waterbird Sanctuary to Ben Boyd National Park adjoining Panboola. The work involved 1 ½ km of fencing and direct seeding of trees, shrubs and sedges and the planting of 3000 tube stock. (PWHP, 2009a). The 'Riparian Planting Project' was also completed. The work for this project involved 500m² of weed matting and planted trees, shrubs and understorey plants adjacent to the Pambula River to assisting with river bank stabilization and the filtration of water flow to the river from the floodplain. (PWHP, 2009b). Both of these projects were completed in 2009 (PWHP, 2009a, PWHP, 2009b).

Panboola is a community project with a committee and management board. Panboola has had heavy involvement with many community groups including Service Clubs, schools and Landcare (IronoutVCAConsultants, 2006).

1.1 STUDY AIMS

The value of long-term data in ecological studies has been recognised as critical for providing insights such as ecological response to ecosystem change, particularly in a rehabilitation context (Lindenmayer et al., 2012). PWHP and FSCB recognise this and engaged EnviroKey

to provide a report on 20 years of bird survey data collected at Panboola. Consequently, this report has the following aims:

- To collate the results of the bird surveys into a single report
- To determine the overall species diversity and report on any apparent trends in bird diversity
- To provide general discussion as to the bird diversity at Panboola
- To discuss the rehabilitation work in the context of bird diversity

2 METHODOLOGY

2.1 BIRD SURVEYS

Bird surveys were carried out by the Far South Coast Birdwatchers between spring 1997 and spring 2016 (n = 77 surveys; autumn = 19, winter = 19, spring = 20, summer = 19). Surveys were not completed between spring 2000 and autumn 2001 inclusive. Bird species diversity was recorded quarterly and in the middle of each season. The survey follows the same route (see **Map 2**), although the direction may vary from time to time. The route takes about 3 hours to complete and observations begin between 7.30am and 8.30am depending on the season. All species observed or heard were recorded.

The number of participants for each survey varied each time with no more than 10 people on any single occasion. A minimum of three experienced birdwatchers take part for each survey. Most observers use binoculars and sightings are verified by more than one observer on most occasions. Abundance of a species is noted when larger numbers than usual are present.

Opportunistic sightings of birds at Panboola outside of the scheduled surveys are also recorded on the FSCB database.



Map 2: Location of bird survey transects at Panboola.

2.2 STUDY AREA

The study area is located in the South East Corner Bioregion (Thackway and Creswell, 1995, NPWS, 2003), Bega Valley local government area (LGA), and South East Local Land Service (LLS) region. All photographs included were provided by Robyn Kesby of PWHP.

2.2.1 Floodplain Forest

Floodplain Forest habitat can be found within the Waterbird Sanctuary (WBS) at Panboola (**Photo 1 & 2**). The Floodplain Forest was the result of significant rehabilitation activities carried out in 2002 and is now a semi-mature closed forest dominated by Water Gum, *Melaleuca ericifolia*, and Lomandra. Small, grassy clearings are also present. This habitat is consistent with River Flat Eucalypt Forest on Coastal Floodplains EEC as listed by the NSW *Biodiversity Conservation Act 2016* (BC Act).



Photo 1: View into the Waterbird Sanctuary from the main entrance of Panboola.



Photo 2: View into the Waterbird Sanctuary looking east.

2.2.2 *Freshwater Billabong*

Freshwater Billabong habitat provides significant aquatic freshwater habitat at Panboola. Tips Billabong and Watsons Waterhole form this habitat which is best described as open water, with scattered emergent such as Common Reed with grassy banks and occasional eucalypts (**Photo 3 & 4**). This habitat is consistent with Freshwater Wetland on Coastal Floodplains EEC as listed by the BC Act.



Photo 3: View across Tips Billabong from Smiths Lookout.



Photo 4: View across Watsons from the Panboola office building.

2.2.3 Saltmarsh

Saltmarsh habitat provides significant estuarine habitat at Panboola. The old racecourse and Olwyns Link form this habitat which is best described as waterlogged flats with a variety of succulents and patches of Common Reed and other salt tolerant flora (**Photo 5**). This habitat is consistent with Coastal Saltmarsh EEC as listed by the BC Act and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).



Photo 5: Saltmarsh near the old racecourse at Panboola.

2.2.4 *Riparian and Floodplain Shrubland*

Riparian and Floodplain Shrubland habitat can be found along Pambula River at Panboola. These habitats are the result of significant rehabilitation activities amongst remnant vegetation occurring along the river (**Photo 6**) and on the adjoining floodplain

This habitat is consistent with River Flat Eucalypt Forest on Coastal Floodplains EEC as listed by the BC Act.



Photo 6: Dense shrubby vegetation as part of plantings along Pambula River



Photo 7: Dense shrubland as part of plantings along the Pambula River floodplain

2.3 ANALYSIS OF DATA

Data provided by FSCB was reviewed and analysed using Microsoft Excel 2013. Graphs were produced using Microsoft Excel 2013.

2.4 LIMITATIONS

A common limitation of many biodiversity studies is the short period of time in which they are conducted. When combined with a lack of seasonal sampling this can lead to either low detection rates or false absences being reported. This is also particularly relevant to highly mobile species such as birds that may not have been in the study area at the time of the survey. However, data used to create this report has been collected over a 20 years period and over all seasons, resulting in a detailed and comprehensive dataset unlikely to have any limitations.

3 RESULTS

3.1 OVERALL SPECIES DIVERSITY

During the survey period, a total of 173 species of bird have been recorded at Panboola. During the specific bird surveys (ie, spring, summer, autumn, winter surveys) a total of 141 species of bird have been recorded. The remaining species were recorded opportunistically; that is outside of specific bird surveys.

The highest number of species recorded was in 2016 (91 species), and the lowest number of species recorded was in 1997 (32 species) (**Figure 1**). Generally, species diversity has increased over the survey period.

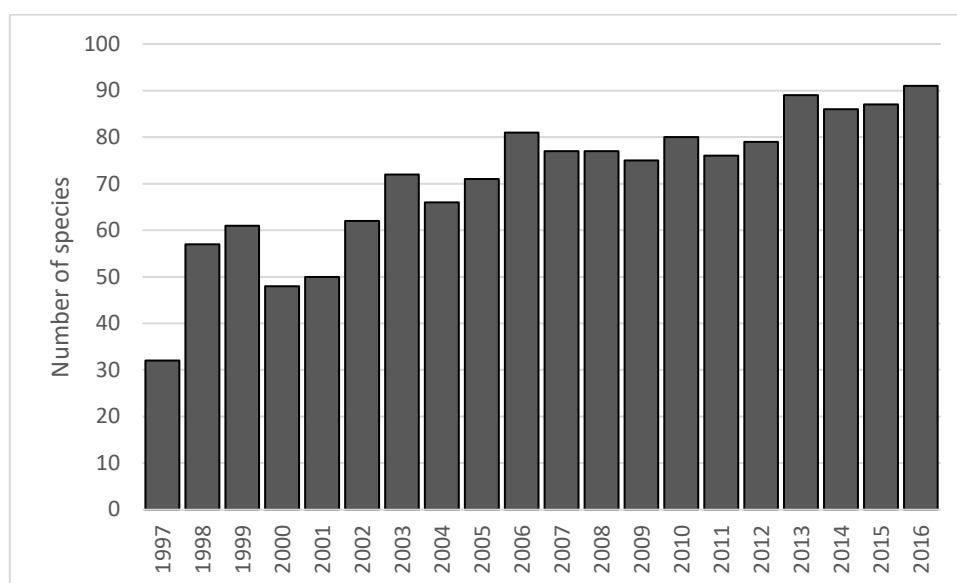


Figure 1: Number of species detected each year at Panboola.

3.2 SEASONALITY OF SPECIES PRESENCE

Seasonality played a role in determining species presence at Panboola. The highest bird diversity when all data is pooled was recorded in summer (n=113) and spring (n=112), with the lowest diversity recorded in winter (n=95) (**Table 1**).

Table 1: Number of species present during each season at Panboola.

Season	No. of species present
Spring	112
Summer	113
Autumn	106

Season	No. of species present
Winter	95

Some bird species were recorded consistently across all seasons at Panboola during the 77 bird surveys) (eg, Purple Swamphen, n=74; Australian Magpie, n=72; Masked Lapwing, n=72). Other species recorded consistently across all seasons and during all surveys included the Pacific Black Duck (n=69), Galah (n=69), Magpie Lark (n=68), Common Starling (n=66), Australian White Ibis (n=65), Australian Wood Duck (n=62), Little Pied Cormorant (n=60) and Chestnut Teal (n=60).

Table 2: Number of bird surveys that each bird species was detected during each season (maximum number of surveys is autumn = 19, winter = 19, spring = 20, summer = 19; total 77 surveys).

Common Name	Spring	Summer	Autumn	Winter
Australasian Darter	1	4	0	1
Australasian Grebe	9	8	10	9
Australasian Pipit	3	11	4	3
Australasian Shoveler	1	1	0	1
Australian Hobby	0	6	0	0
Australian King-Parrot	1	1	10	1
Australian Magpie	19	17	18	19
Australian Pelican	4	2	2	4
Australian Raven	17	16	17	17
Australian Reed-Warbler	1	16	3	1
Australian White Ibis	18	12	17	18
Australian Wood Duck	17	14	14	17
Azure Kingfisher	0	1	1	0
Black Swan	18	9	16	18
Black-faced Cuckoo-shrike	2	14	10	2
Black-fronted Dotterel	3	3	8	3
Black-shouldered Kite	10	9	9	10
Brown Falcon	0	1	2	0
Brown Goshawk	0	0	2	0
Brown Quail	1	1	1	1
Brown Thornbill	17	9	12	17

Common Name	Spring	Summer	Autumn	Winter
Brown-headed Honeyeater	0	1	2	0
Buff-banded Rail	0	2	0	0
Cattle Egret	9	0	12	9
Chestnut Teal	17	12	14	17
Collared Sparrowhawk	0	2	0	0
Common Blackbird	10	13	12	10
Common Bronzewing	0	1	0	0
Common Starling	17	18	14	17
Crescent Honeyeater	6	0	2	6
Crested Pigeon	8	9	8	8
Crested Shrike-tit	0	2	0	0
Crimson Rosella	16	10	14	16
Dusky Moorhen	6	6	4	6
Dusky Woodswallow	0	4	2	0
Eastern Barn Owl	1	0	1	1
Eastern Great Egret	12	15	15	12
Eastern Koel	0	1	0	0
Eastern Rosella	7	9	10	7
Eastern Spinebill	7	4	7	7
Eastern Whipbird	10	10	5	10
Eastern Yellow Robin	6	6	4	6
Eurasian Coot	15	13	14	15
Eurasian Skylark	1	2	0	1
European Goldfinch	3	10	11	3
Fan-tailed Cuckoo	3	2	0	3
Freckled Duck	1	0	0	1
Galah	19	17	14	19
Gang-gang Cockatoo	0	10	0	0
Golden Whistler	3	3	5	3
Golden-headed Cisticola	9	18	8	9
Great Cormorant	3	0	4	3
Grey Butcherbird	11	11	13	11
Grey Fantail	10	14	11	10
Grey Goshawk	4	0	3	4
Grey Shrike-thrush	12	6	11	12

Common Name	Spring	Summer	Autumn	Winter
Grey Teal	10	7	6	10
Hardhead	5	3	1	5
Hoary-headed Grebe	1	1	2	1
Horsfield's Bronze-Cuckoo	0	5	0	0
House Sparrow	4	7	2	4
Intermediate Egret	0	1	1	0
Jacky Winter	7	4	5	7
Latham's Snipe	0	3	0	0
Laughing Kookaburra	8	9	11	8
Lewin's Honeyeater	0	0	3	0
Little Black Cormorant	3	10	6	3
Little Corella	1	0	1	1
Little Eagle	2	1	3	2
Little Grassbird	2	6	4	2
Little Lorikeet	1	0	0	1
Little Pied Cormorant	15	14	16	15
Little Raven	0	0	3	0
Little Wattlebird	2	3	5	2
Magpie Goose	0	0	1	0
Magpie-lark	18	15	17	18
Masked Lapwing	19	16	18	19
Nankeen Kestrel	14	7	8	14
Nankeen Night-Heron	0	8	2	0
New Holland Honeyeater	9	13	4	9
Noisy Friarbird	0	3	1	0
Northern Mallard	1	1	1	1
Olive-backed Oriole	0	0	2	0
Pacific Black Duck	18	15	18	18
Peregrine Falcon	0	2	1	0
Pied Currawong	5	1	4	5
Purple Swamphen	19	18	18	19
Rainbow Lorikeet	4	3	3	4
Red Wattlebird	9	8	15	9
Red-browed Finch	5	8	5	5
Red-kneed Dotterel	0	1	0	0

Common Name	Spring	Summer	Autumn	Winter
Restless Flycatcher	0	0	2	0
Royal Spoonbill	3	4	4	3
Rufous Fantail	0	2	0	0
Rufous Whistler	0	11	0	0
Sacred Kingfisher	0	2	0	0
Satin Bowerbird	0	1	1	0
Scarlet Honeyeater	0	3	0	0
Shining Bronze-Cuckoo	0	2	1	0
Silvereye	7	11	9	7
Southern Emu-wren	4	8	6	4
Spotted Dove	6	9	4	6
Spotted Pardalote	4	3	4	4
Straw-necked Ibis	6	4	7	6
Striated Heron	0	1	0	0
Striated Thornbill	1	2	0	1
Stubble Quail	0	2	0	0
Sulphur-crested Cockatoo	3	10	3	3
Superb Fairy-wren	18	17	16	18
Swamp Harrier	8	13	3	8
Tree Martin	1	1	0	1
Varied Sittella	0	1	1	0
Variegated Fairy-wren	1	1	0	1
Wedge-tailed Eagle	4	0	5	4
Welcome Swallow	16	15	18	16
Whiskered Tern	0	0	2	0
Whistling Kite	13	11	14	13
White-bellied Cuckoo-shrike	0	0	1	0
White-bellied Sea-Eagle	5	5	10	5
White-browed Scrubwren	5	3	6	5
White-eared Honeyeater	2	0	1	2
White-faced Heron	16	14	18	16
White-fronted Chat	7	0	1	7
White-headed Pigeon	0	0	1	0
White-naped Honeyeater	1	1	4	1
White-necked Heron	3	0	1	3

Common Name	Spring	Summer	Autumn	Winter
White-throated Needletail	0	3	0	0
White-throated Treecreeper	0	1	0	0
White-winged Triller	0	4	0	0
Willie Wagtail	19	17	18	19
Yellow Thornbill	9	6	6	9
Yellow-faced Honeyeater	3	12	12	3
Yellow-rumped Thornbill	10	10	10	10
Yellow-tailed Black-Cockatoo	2	4	3	2

3.3 HABITAT OCCUPANCY

The four habitat types present at Panboola provide significant habitat, either temporarily or permanently. Over the 20-year period, Saltmarsh habitat was found to support the most number of species records (n=122) with the Riparian and Floodplain shrubland supporting the least (n=92) (**Table 3**).

Table 3: Number of bird species recorded within each habitat type over the 20-year survey period

Habitat type	No. of species present
Floodplain Forest	100
Freshwater Billabong	114
Saltmarsh	122
Riparian and Floodplain Shrubland	92

Individual habitat occupancy was also reviewed for each species. This data provides a general overview of potential habitat preferences, either at Panboola specifically, or more broadly across species distribution. Species such as Australian Magpie should be regarded as habitat generalists occurring in all habitat types at Panboola (FF=48, FB=55, SM=63, RFS=34), while Azure Kingfisher has only been detected in freshwater billabong confirming it is a habitat specialist (**Table 4**). Only 21 species have been recorded in a single habitat at Panboola (Azure Kingfisher, Brown Falcon, Common Bronzewing, Crested Shrike-tit, Freckled Duck, Hardhead, Lewin's Rail, Little Lorikeet, Musk Lorikeet, Nankeen Night-heron, Northern Mallard, Pallid Cuckoo, Peaceful Dove, Red-kneed Dotterel, Sharp-tailed Sandpiper, Silver Gull, Striated Heron, Varied Sittella, Whiskered Tern, White-headed Pigeon, and White-winged Triller).

Table 4: Number of surveys that each species was detected within each habitat type.

Common Name	Floodplain Forest	Freshwater Billabong	Saltmarsh	Riparian and Floodplain Shrubland
Australasian Darter	0	4	0	1
Australasian Grebe	3	38	0	0
Australasian Pipit	6	6	19	6
Australasian Shoveler	1	4	0	0
Australian Hobby	0	0	7	2
Australian King-Parrot	9	4	2	1
Australian Magpie	48	55	63	34
Australian Pelican	1	1	7	3
Australian Raven	17	24	36	13
Australian Reed-Warbler	23	33	4	3
Australian White Ibis	22	33	38	12
Australian Wood Duck	23	43	21	4
Azure Kingfisher	0	2	0	0
Baillon's Crake	1	4	0	0
Black Swan	20	52	9	4
Black-faced Cuckoo-shrike	10	12	21	7
Black-fronted Dotterel	7	7	3	1
Black-shouldered Kite	3	10	29	10
Brown Falcon	0	0	3	0
Brown Goshawk	1	0	1	0
Brown Quail	1	1	2	0
Brown Thornbill	16	17	37	23
Brown-headed Honeyeater	1	0	2	0
Buff-banded Rail	2	4	0	1
Cattle Egret	4	9	16	7
Chestnut Teal	22	46	7	3
Collared Sparrowhawk	0	0	2	0
Common Blackbird	26	28	14	6
Common Bronzewing	0	0	1	0
Common Starling	21	22	55	20
Crescent Honeyeater	0	3	4	1
Crested Pigeon	12	8	19	6
Crested Shrike-tit	0	0	2	0

Common Name	Floodplain Forest	Freshwater Billabong	Saltmarsh	Riparian and Floodplain Shrubland
Crimson Rosella	13	11	38	23
Dusky Moorhen	9	13	0	1
Dusky Woodswallow	1	0	6	2
Eastern Barn Owl	1	0	2	0
Eastern Great Egret	19	29	24	1
Eastern Koel	1	2	0	0
Eastern Rosella	3	3	32	6
Eastern Spinebill	5	12	7	3
Eastern Whipbird	22	17	9	2
Eastern Yellow Robin	7	4	9	2
Eurasian Coot	14	64	0	1
Eurasian Skylark	1	1	1	6
European Goldfinch	10	7	23	10
Fan-tailed Cuckoo	1	1	10	3
Freckled Duck	0	1	0	0
Galah	21	40	30	23
Gang-gang Cockatoo	5	7	1	0
Golden Whistler	5	7	4	2
Golden-headed Cisticola	12	12	29	19
Great Cormorant	0	9	5	1
Grey Butcherbird	13	21	28	12
Grey Fantail	29	34	29	20
Grey Goshawk	1	0	7	0
Grey Shrike-thrush	5	8	21	8
Grey Teal	6	20	7	2
Hardhead	0	21	0	0
Hoary-headed Grebe	0	5	1	0
Horsfield's Bronze-Cuckoo	5	1	4	2
House Sparrow	13	2	7	0
Intermediate Egret	1	1	2	0
Jacky Winter	2	2	13	2
Latham's Snipe	3	5	2	1
Laughing Kookaburra	12	11	16	5

Common Name	Floodplain Forest	Freshwater Billabong	Saltmarsh	Riparian and Floodplain Shrubland
Lewin's Honeyeater	0	2	1	0
Lewin's Rail	0	1	0	0
Little Black Cormorant	2	25	4	2
Little Corella	0	3	4	1
Little Eagle	1	1	5	0
Little Grassbird	15	20	2	1
Little Lorikeet	0	0	1	0
Little Pied Cormorant	12	39	21	9
Little Raven	0	1	2	1
Little Wattlebird	13	10	7	2
Magpie Goose	2	1	0	0
Magpie-lark	20	31	48	14
Masked Lapwing	20	55	33	15
Musk Lorikeet	0	0	1	0
Nankeen Kestrel	5	3	28	3
Nankeen Night-Heron	0	13	0	0
New Holland Honeyeater	15	16	21	1
Noisy Friarbird	2	1	5	2
Northern Mallard	0	3	0	0
Olive-backed Oriole	1	0	0	1
Pacific Black Duck	31	65	12	5
Pallid Cuckoo	0	0	1	0
Peaceful Dove	0	0	1	0
Peregrine Falcon	0	0	2	2
Pied Currawong	5	2	6	2
Purple Swamphen	61	74	13	11
Rainbow Lorikeet	6	7	10	3
Red Wattlebird	10	14	35	10
Red-browed Finch	6	2	12	4
Red-kneed Dotterel	0	0	1	0
Restless Flycatcher	0	1	2	0
Royal Spoonbill	1	13	5	1
Rufous Fantail	1	0	1	0

Common Name	Floodplain Forest	Freshwater Billabong	Saltmarsh	Riparian and Floodplain Shrubland
Rufous Whistler	6	6	17	13
Sacred Kingfisher	2	1	0	0
Satin Bowerbird	0	1	1	1
Scarlet Honeyeater	2	1	6	0
Sharp-tailed Sandpiper	0	0	1	0
Shining Bronze-Cuckoo	6	3	6	3
Silver Gull	0	0	1	0
Silvereeye	10	19	13	11
Southern Emu-wren	0	2	12	10
Spotted Dove	10	19	1	3
Spotted Pardalote	5	8	8	0
Straw-necked Ibis	5	11	10	10
Striated Heron	0	0	0	1
Striated Thornbill	1	1	2	0
Stubble Quail	0	0	1	2
Sulphur-crested Cockatoo	1	11	6	3
Superb Fairy-wren	45	55	52	31
Swamp Harrier	3	16	23	6
Tree Martin	0	1	2	0
Varied Sittella	0	0	2	0
Variegated Fairy-wren	0	1	1	0
Wedge-tailed Eagle	0	5	8	0
Welcome Swallow	30	60	47	13
Whiskered Tern	0	0	2	0
Whistling Kite	10	14	32	4
White-bellied Cuckoo-shrike	0	1	1	0
White-bellied Sea-Eagle	4	3	14	4
White-browed Scrubwren	5	2	10	10
White-eared Honeyeater	1	1	1	1
White-faced Heron	14	22	55	12
White-fronted Chat	2	1	6	1
White-headed Pigeon	1	0	0	0
White-naped Honeyeater	0	2	5	1

Common Name	Floodplain Forest	Freshwater Billabong	Saltmarsh	Riparian and Floodplain Shrubland
White-necked Heron	0	3	2	3
White-throated Needletail	0	1	2	1
White-throated Treecreeper	1	0	1	0
White-winged Triller	0	0	5	0
Willie Wagtail	22	40	45	19
Yellow Thornbill	5	12	14	7
Yellow-faced Honeyeater	18	9	33	16
Yellow-rumped Thornbill	12	15	16	15
Yellow-tailed Black-Cockatoo	1	5	8	0

3.4 THREATENED AND MIGRATORY SPECIES

Panboola has long been thought to be an important wetland for a number of threatened and migratory species. The dataset reveals a total of 29 listed species (threatened or migratory) that have been recorded at Panboola, either during formal bird surveys or opportunistically by FSCB members or Panboola staff or volunteers (**Table 5**).

Table 5: Threatened and Migratory species recorded at Panboola and their legal status (BC Act= NSW *Biodiversity Conservation Act 2016*, EPBC Act= Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, V= vulnerable, E= endangered, LM= Listed Marine, B= Bonn, C=CAMBA, J=JAMBA, R=ROKAMBA.

COMMON NAME	BC ACT	EPBC ACT
Australasian Bittern	E	E
Black Bittern	V	-
Cattle Egret	-	LM
Common Greenshank	-	B, C, J, R
Dusky Woodswallow	V	-
Eastern Great Egret	-	LM
Flame Robin	V	-
Freckled Duck	V	-
Gang-gang Cockatoo	V	-
Glossy Black-Cockatoo	V	-
Glossy Ibis	-	LM, B
Intermediate Egret	-	LM
Latham's Snipe	-	LM, B, J, R

COMMON NAME	BC ACT	EPBC ACT
Little Eagle	V	-
Little Egret	-	B
Little Lorikeet	V	-
Magpie Goose	V	-
Masked Owl	V	-
Pacific Golden Plover	-	LM, B, C, J, R
Red-necked Stint	-	LM, B, C, J, R
Rufous Fantail	-	LM, B
Scarlet Robin	V	-
Sharp-tailed Sandpiper	-	LM, B, C, J, R
Spotted Harrier	V	-
Square-tailed Kite	V	-
Varied Sittella	V	-
White-bellied Sea-Eagle	V	LM
White-fronted Chat	V	-
White-throated Needletail	-	LM, C, J, R

3.5 SEASONAL SPECIES DIVERSITY BY YEAR

Seasonal species diversity has generally increased over the 20-year survey period with some variability observed in the data (**Figure 2**). Generally, bird diversity in spring and summer is consistently higher when compared against each year of the survey period. No general patterns in the data were found when comparing suites of birds, such as waterbirds and different seasons or years.

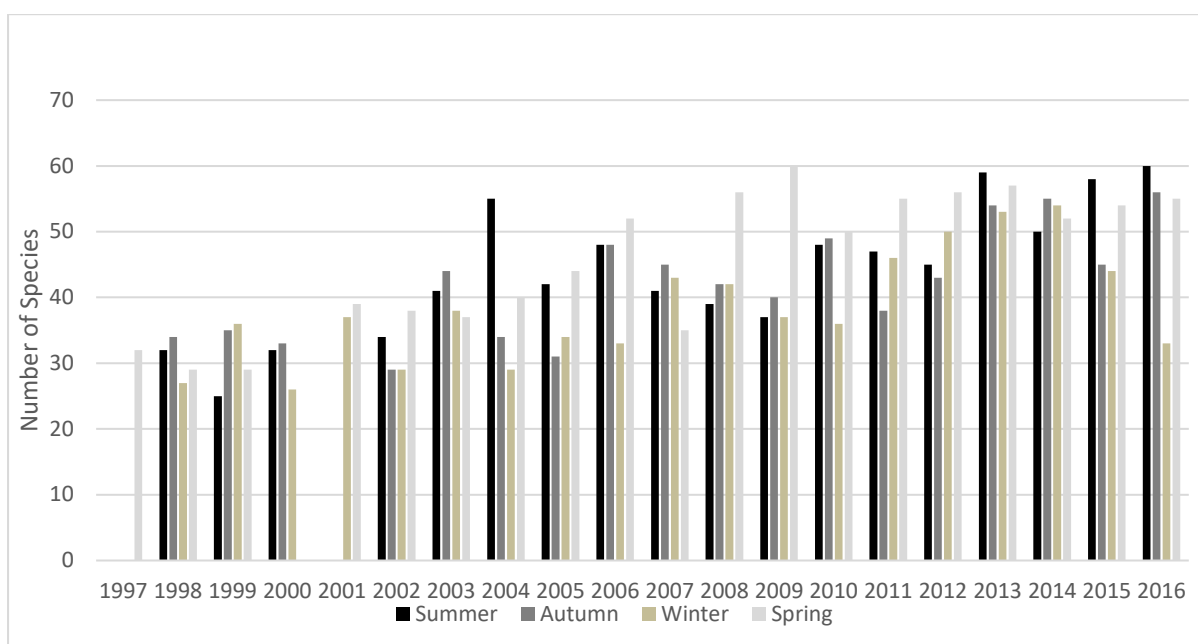


Figure 2: Number of species detected each season in each year at Panboola.

3.6 OPPORTUNISTIC DATA

Of the total species diversity recorded at Panboola during the survey period, a number of species have been detected at Panboola in addition to those recorded within the formal bird surveys. A total of 30 species have been recorded outside of formal bird surveys (**Table 6**). This has included nine threatened and migratory birds (out of the 29 species recorded to date). The relevant species of each site is also provided in **Table 6**.

Table 6: Bird species recorded outside of formal bird surveys (ie, opportunistic records).

COMMON NAME	SPRING	SUMMER	AUTUMN	WINTER
Australasian Bittern	R			
Australasian Figbird	R			
Australian Shelduck		R		
Australian Spotted Crake	R			
Black Bittern	R		R	R
Blue-winged Parrot			R	
Brush Cuckoo			R	
Channel-billed Cuckoo	R	R	R	
Common Greenshank		R		
Common Myna	Recorded but season not in data			
Double-barred Finch			R	

COMMON NAME	SPRING	SUMMER	AUTUMN	WINTER
Fairy Martin	R			R
Flame Robin				R
Glossy Black-Cockatoo			R	R
Glossy Ibis	R			R
Grey Currawong			R	
Leaden Flycatcher	Recorded but season not in data			
Little Egret	R			
Masked Owl			R	
Mistletoebird	R	R	R	R
Pacific Golden Plover	R			
Plumed Whistling-Duck		R		R
Red-necked Stint	Recorded but season not in data			
Rose Robin			R	R
Rufous Songlark	R			
Scarlet Robin			R	R
Spotless Crake	R	R		
Spotted Harrier		R	R	
Square-tailed Kite	R			
Yellow-billed Spoonbill		R	R	R

4 DISCUSSION

4.1 OVERALL SPECIES DIVERSITY

Panboola supports a significant number of bird species with 173 species recorded during the 20-year survey period. This accounts for about 51% of all recorded bird species (n=339) in the Bega Valley LGA (OEH, 2017). This is an outstanding result for a site of less than 100 hectares and with consideration that Panboola does not provide the diversity of habitats that occur across the LGA including oceanic, rainforest, heath and wet sclerophyll forest. The data supports an existing listing in the Nationally Important Wetland Register for the Pambula Estuarine Wetlands (which includes Panboola) (DotE, 2015) and areas mapped as SEPP 14 coastal wetlands protected under NSW legislation, given this high species diversity.

4.2 SEASONALITY OF SPECIES PRESENCE

Bird diversity is known to vary across seasons and across differing landscapes (Watson, 2004, Roshier and Reid, 2003, Roshier et al., 2002). In this dataset at Panboola, bird diversity is considered relatively stable throughout the seasons despite observed differences between summer and winter. This may be attributed to the relative permanency of the water bodies at Panboola as more ephemeral type wetlands are likely to have less diversity when wetlands disappear.

4.3 HABITAT OCCUPANCY

It was not surprising that potential patterns of habitat occupancy were showing in the dataset with some species recorded only in a single habitat type, or across all habitat types. It is well known that many species of bird can be assigned as habitat generalists, meaning that they occur a diverse range of differing habitats, or habitat specialists, relying solely on a single or on a couple of habitat types (Cody, 1974, Devictor et al., 2008). When considering the potential for habitat specificity, the dataset may be biased towards a lack of observations, even though it spans a 20-year period. For example, it is unlikely that Peaceful Dove is a habitat specialist. It has only been recorded from the Saltmarsh area, however, this species is known to occur across a range of different habitats (Morcombe, 2004) and could feasibly occur in other habitats of Panboola, but has just gone undetected to date. Given the generally higher mobility of birds in comparison to other taxa such as frogs and reptiles who are well known for habitat specificity and small home ranges (Koenig et al., 2001, Sass et al., 2011), further data would be needed to make more robust statements about habitat occupancy. Rather, the existing dataset provides a good generalisation of where species may be most reliably detected at Panboola. This factor is likely of considerable importance when planning further rehabilitation work at Panboola, or in the production of fact sheet type information for bird watchers and naturalists.

4.4 THREATENED AND MIGRATORY SPECIES

In the Bega Valley LGA, 90 threatened and migratory bird species have been previously recorded (OEH, 2017). However, with the exclusion of the shearwaters, albatross and petrels for which no oceanic habitat occurs at Panboola, a total of 78 species are known from more terrestrial habitats. The 20-year survey data reveals the known presence, either long-term or sporadically, of 29 threatened and migratory bird species representing 37% of these listed species previously recorded. In comparison to the Bermagui wetlands area including Wallaga Lake and Bermagui River, 43 threatened and migratory species are known from previous records at that location (OEH, 2017). However, those wetlands also comprise large areas of mud and sandflats (two habitat types missing from Panboola), which are likely to have a large influence on migratory bird presence. Nonetheless, the current dataset demonstrates the relative significance of Panboola to threatened and migratory species which is likely to be of national importance.

4.5 SEASONAL SPECIES DIVERSITY BY YEAR

The results of the 20-year data set show a general increase in the number of bird species recorded both seasonally and yearly at Panboola. Given the large-scale rehabilitation efforts on the site over this time and a general change in landuse from agricultural to conservation management, the gradual increase in bird diversity is not surprising. Birds are well known for their response to environmental change, and in particular, rehabilitation activity including wetlands (VanRees-Siewert and Dinsmore, 1996, Romanowski, 2010, Johnson et al., 2007, Vesk and Mac Nally, 2006, Fischer and Lindenmayer, 2002, Nichols and Nichols, 2000).

4.6 OPPORTUNISTIC DATA

While standardized searches are considered the most appropriate way to conduct bird surveys (Watson, 2003), the value of opportunistic data should not be underestimated. An additional 30 species were detected outside of formal, standardized bird surveys, including nine threatened and migratory species. This study confirms the high value that opportunistic data can bring to the understanding of species presence at a site, and more importantly, provide important data for rare and vagrant species who may be at a site only temporarily or are difficult to detect. In this instance, any omission of opportunistic data would have resulted in only 20 threatened and migratory species being recorded (not the 29 species that actually were).

5 CONCLUSION

The collection of 20-years of bird survey data from Panboola has provided a significant contribution to the knowledge of birds including wetland species. Our review of this data has revealed:

- significant trends relating to increases in bird diversity over time, likely an artefact of changes in land management and the success of targeted rehabilitation work by PWHP with a focus on improving habitats.
- that Panboola provides significant habitat for at least 29 threatened and migratory species likely to be of national importance.
- the permanent nature of the wetlands at Panboola may be contributing to a relatively stable seasonal diversity.
- some species may rely on specific habitats which is an important consideration when planning future rehabilitation work or in the production of fact type sheets and other information for bird watchers and naturalists.
- The importance of collecting opportunistic data, ie, outside of standardized or formal bird surveys. Opportunistic data in this study revealed an additional 30 species including 9 threatened and migratory species.



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6 REFERENCES

- CODY, M. L. 1974. *Competition and the structure of bird communities*, Princeton University Press.
- DEVICTOR, V., JULLIARD, R. & JIGUET, F. 2008. Distribution of specialist and generalist species along spatial gradients of habitat disturbance and fragmentation. *Oikos*, 117, 507-514.
- NOTE 2015. Directory of Important Wetlands in Australia.
<http://www.environment.gov.au/topics/water/water-our-environment/wetlands/australian-wetlands-database/directory-important>.
- FINLAYSON, C. M. & REA, N. 1999. Reasons for the loss and degradation of Australian wetlands. *Wetlands Ecology and Management*, 7, 1-11.
- FISCHER, J. & LINDENMAYER, D. B. 2002. Small patches can be valuable for biodiversity conservation: two case studies on birds in southeastern Australia. *Biological Conservation*, 106, 129-136.
- GEORGE, A. & RAYMOND, P. 2006. Discover Pambula - Walk in the pioneers' footsteps. Pambula Area Progress and Planning Association Inc.
- GROWERS, P. L. O. 2011. Pambula Lake Oyster Growers' Environmental Management System.
- IRONOUTVCACONSULTANTS 2006. Panboola Plan of Management.
- JOHNSON, M., REICH, P. & MAC NALLY, R. 2007. Bird assemblages of a fragmented agricultural landscape and the relative importance of vegetation structure and landscape pattern. *Wildlife Research*, 34, 185-193.
- KOENIG, J., SHINE, R. & SHEA, G. 2001. The ecology of an Australian reptile icon: how do blue-tongued lizards (*Tiliqua scincoides*) survive in suburbia? *Wildlife Research*, 28, 215-227.
- LINDENMAYER, D. B., LIKENS, G. E., ANDERSEN, A., BOWMAN, D., BULL, C. M., BURNS, E., DICKMAN, C. R., HOFFMANN, A. A., KEITH, D. A. & LIDDELL, M. J. 2012. Value of long-term ecological studies. *Austral Ecology*, 37, 745-757.
- MITSCH, W. J. & GOSSELINK, J. G. 2000. The value of wetlands: importance of scale and landscape setting. *Ecological Economics*, 35, 25-33.
- MORCOMBE, M. 2004. *Field guide to Australian Birds*, Australia, Steve Parish Publishing.
- NICHOLS, O. G. & NICHOLS, F. M. 2000. Long-term trends in faunal recolonisation after bauxite mining in the jarrah forest of southwestern Australia. *Restoration Ecology*, 11, 261-272.
- NPWS 2003. The Bioregions of New South Wales: their biodiversity, conservation and history. *NSW National Parks and Wildlife Service, Hurstville*.
- OEHL. 2017. *BioNET: The website for the Atlas of NSW Wildlife: A whole-of-government system for flora and fauna sightings information* [Online]. Available: www.bionet.nsw.gov.au [Accessed].
- PWHP 2009a. Panboola Newsletter No: 15.
- PWHP 2009b. Panboola Newsletter No 16.
- PWHP. 2014. *Panboola - About Us* [Online]. Available: <http://panboola.com/about-us/> [Accessed 9/9/2014].
- ROMANOWSKI, N. 2010. *Wetland Habitats: A Practical Guide to Restoration and Management*, Collingwood, Victoria, CSIRO Publishing.
- ROSHIER, D. A. & REID, J. R. W. 2003. On animal distributions in dynamic landscapes. *Ecography*, 26, 539-544.
- ROSHIER, D. A., ROBERTSON, A. I. & KINGSFORD, R. T. 2002. Responses of waterbirds to flooding in an arid region of Australia and implications for conservation. *Biological Conservation*, 106, 399-411.
- SASS, S., SWAN, G., MARSHALL, B., BROWNE, T. & GRAHAM-HIGGS, N. 2011. Disjunct population of spinifex-obligate reptiles revealed in a newly described vegetation

- community near Broken Hill, far-western New South Wales. *Australian Zoologist*, 35, 781-787.
- THACKWAY, R. & CRESWELL, I. D. 1995. An interim biogeographic regionalisation for Australia: a framework for establishing the national system of reserves. Version 4.0. *Australian Nature Conservation Agency, Canberra*.
- VANREES-SIEWERT, K. L. & DINSMORE, J. J. 1996. Influence of wetland age on bird use of restored wetlands in Iowa. *Wetlands*, 16, 577-582.
- VESK, P. A. & MAC NALLY, R. 2006. The clock is ticking - Revegetation and habitat for birds and arboreal mammals in rural landscapes of southern Australia. *Agriculture Ecosystems & Environment*, 112, 356-366.
- WATSON, D. M. 2003. The 'standardized search' : An improved way to conduct bird surveys. *Austral Ecology*, 28, 515:525.
- WATSON, D. M. 2004. Comparative evaluation of new approaches to survey birds. *Wildlife Research*, 31.

7 APPENDICES

APPENDIX 1 – QUALIFICATIONS AND EXPERIENCE OF PERSONNEL

Name and Qualifications	Experience
<p>Steve Sass B.App.Sci (Env.Sci) (Hons), GradCert.CaptVertMngt (CSU) Director / Principal Ecologist</p> <p>Certified Environmental Practitioner, EIANZ</p> <p>OEH Accredited Biodiversity Assessor</p> <p>Member, Ecological Consultants Association of NSW</p>	<p>Steve is a highly experienced Ecologist having undertaken hundreds of terrestrial and aquatic ecological surveys and assessments across Australia since 1992. He has an in-depth working knowledge of environmental and biodiversity legislation across all states and territories which allows him to provide detailed and accurate assessments and formulate practical solutions to clients and specific projects on a case-by-case basis.</p> <p>Previous and current research holds Steve in high regard within both the scientific and ecological consultants' community. To date, Steve has published, submitted or has in preparation, thirty manuscripts within peer-reviewed scientific journals, many of which are related to threatened species survey, monitoring or management.</p> <p>In recent years, Steve has been assigned 'Expert' status by the NSW OEH for 23 threatened species (mostly birds).</p>
<p>Linda Sass Ass.Deg. Gn.St (Science), B.A, Dip. Ed (Sec), Cert 3 Captive Animals</p> <p>Director / Senior Ecologist</p> <p>Member, Ecological Consultants Association of NSW (ECA)</p>	<p>Linda is an experienced ecologist having conducted flora and fauna surveys across NSW over the past 12 years.</p> <p>Linda has extensive experience with the flora and fauna of southern and western NSW and has a keen interest in community biodiversity projects and habitat restoration. She is passionate in environmental education and presents her interests through broad educational talks to large groups at On the Perch Bird Park at Tathra where she is also the Senior Bird Keeper.</p>